Unit 12

End of Module

Knowledge Representation and Reasoning

For

M. Sc. In Artificial Intelligence

As required by

University of Essex

Individual Reflection

17th April 2023

The Knowledge representation and reasoning (KRR) module within Artificial Intelligence (AI) was the most challenging and exciting of the modules as it dealt with understanding how and why of the representation of knowledge so that machines can use it to solve problems. The objective of KRR is to build a model that is coupled with accuracy and efficiency.

What?

Being an Architect with hands-on experience in implementing the learnings, I found this to be more related and led me to explore further various approaches to KRR, its strengths and weaknesses, and what are the usual techniques that are involved.

Some were explored during the "Case Study Review" and "Modelling Assignment" while the modules progressed.

For example;

- The easy-to-understand **rule-based systems** use a set of if-then rules. Like First Order Login (FOL), creating statements or building executable logic was challenging during execution for implementation.

- In additional studies, I explored the **semantic networks** representing knowledge as a network of nodes and edges. For example, a diagrammatic representation of relationships between different types of insects.

- Explored more about **frame-based systems** that organise knowledge in a hierarchical structure of objects. Most suited to present complex relationships and structures.

- **Ontologies** the most used modelling method, which specifies the concepts and their relationships in a domain. This approach is well-suited for representing large and complex domains but can be challenging to create and maintain.

During the module and the assignments, it was better understood by doing a pre-study of the assignments, modelling and the units that led to valuable discussions

uncovering most of the queries. I recommend more classroom-based talks that can be referred to repeatedly.

The criticality and outcomes of KRR were mostly followed when I did some studies and implementations of the techniques like;

- The development of expert systems that can mimic the decision-making capabilities of a human expert. They rely heavily on KRR techniques to represent the human expert's knowledge in a way that the machine can use. Expert systems have been developed in many domains, including medicine, law, finance, and engineering (Sowa's Conceptual Structures, 1984).

- Improving natural language processing enables machines to understand and generate human-like language. This has led to the developing of new applications, such as machine translation and chatbots.

- The development of ontologies has been used in various applications, such as information retrieval, the semantic web, and knowledge management.

- The development of automated reasoning has applications in theorem proving, planning, and diagnosis.

Even though KRR has had significant impacts in many areas – computer science, engineering, medicine, finance, etc.-, it still needs to be researched further to improve its features.

I could find some of the challenges that need to be worked on further:

- Scalability – More increase in the volume of knowledge poses more difficulties to KRR about it.

- Uncertainty – Handling of surprises or uncertainty or when the data is skewed.

- Complexity – Managing and maintaining the systems

(Brachman & Levesque, 2004)

Despite these challenges, KRR is a rapidly growing field with many potential applications. As KRR systems become more powerful, they will play an increasingly important role in our lives.

<u>So what?</u>

The problems surrounding using KRR were better understood when I started analysing the assignments and problems discussed during the seminars.

Giving more enhancements to the explanations, I started with exploring FOL and Logic programming using Prolog, Haskell, etc. They are tough but powerful enough to build libraries and integrate with Python applications. I put some time into gaining application integration and working by using libraries like – PySwip or pytholog.

The modelling assignment should have been more about building the ontology within an application. The Protégé tool needs more automation (my personal feeling), and with AI systems evolving more, building ontology as reverse engineering should also be considered. I would also recommend reading about OntoUML (https://ontouml.org/ontouml/).

The ontology specs play an essential role in the entire library architecture along with the database because even with distributed databases for the library, the data needs to be retrieved based on the specs.

The typical architecture that I am currently enhancing to build it into a small application from the assignment:
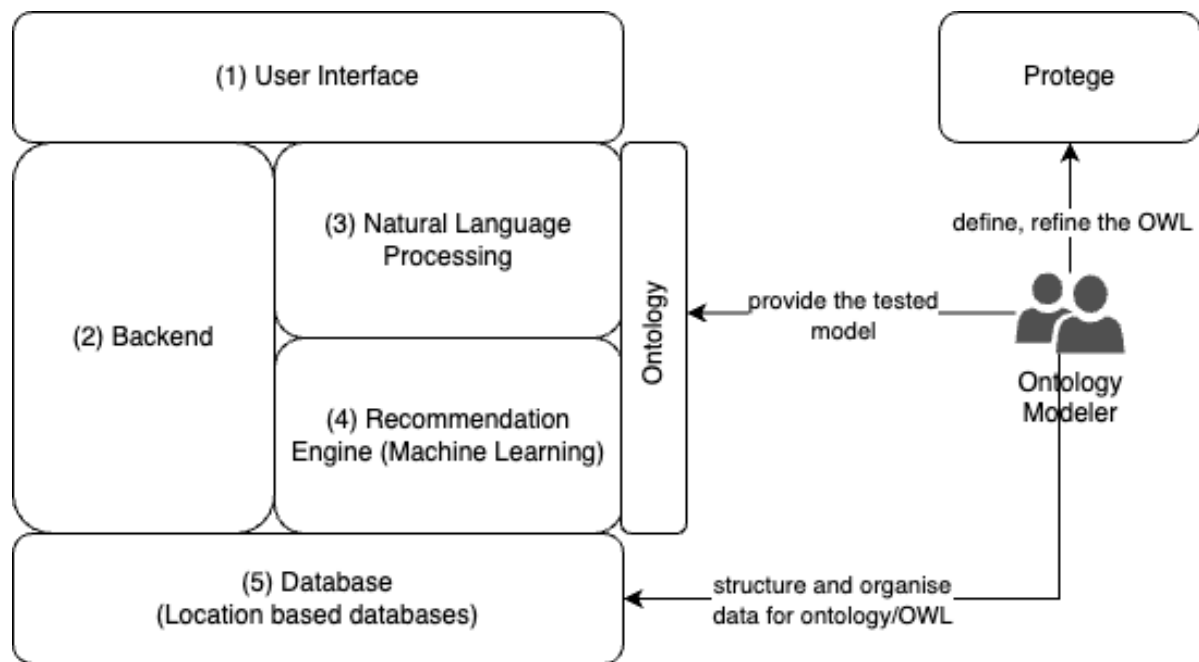
Knowledge representation and reasoning (KRR) is a field of artificial intelligence that deals with the representation of knowledge in a way that machines can use to reason about it. KRR techniques can identify patterns and relationships in data, make predictions, reason about uncertainty, improve knowledge management, and automate decision-making.

Here are some specific examples of how KRR can be used:

- In fraud detection, KRR can be used to identify patterns of suspicious activity.
- In product development, KRR can be used to predict which products are likely to be successful.
- In medical diagnosis, KRR can be used to predict the likelihood of a patient having a particular disease.
- In weather forecasting, KRR can be used to predict the likelihood of rain or snow.
- In financial planning, KRR can be used to predict the likelihood that a particular investment is profitable.

KRR is a powerful tool that can be used to analyse and interpret complex information in various domains. By representing knowledge in a structured format and using

reasoning techniques to conclude, KRR can enable machines to make predictions, automate decision-making, and improve knowledge management.

Now what?

Next, I will build my knowledge by creating a running application using the library search prototype.

However, I plan to enhance my knowledge from KRR in AI in areas for decision-making in finance, for which I am engaged now to explain how the predictions to offers and promotions based on customer buying and thinking can be influenced.

Being in IT, I will also review ontology building and reasoning tools compared to Protégé and find out how VOWL as a plugin can be enhanced to create the owl visually.

The information and learning gained from KRR in AI can be applied in various fields and contexts, depending on specific interests and professional goals.

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